REMARKS

Claims 1-114 were pending prior to the present amendments. Claims 69-114 are withdrawn pursuant to the Examiner's previous restriction requirement. Claims 1, 9 and 11-14 are amended to more particularly point out and distinctly claim Applicant's invention.

In the Office Action of July 18, 2001, the Examiner rejected the pending claims based on prior art references U.S. Patent 5,550,463 ("Coveley") and U.S. Patent 4,504,778 ("Evans"). It is important, at the outset, to point out that both Coveley's and Evans's disclosures are based on the conventional wisdom that requires creating a low voltage DC power supply to provide power to a control circuit that is associated with a semiconductor switch. Both Coveley's and Evan's disclosed control circuits draw a large leakage current through the load during the "off" state, and create a large voltage drop across the semiconductor switch during the "on" state. In addition, both Coveley's and Evans's control circuits change the phase angle to delay the time at which the semiconductor switch turns on, thereby deliberately increasing the voltage drop across the semiconductor switch and resulting in serious distortion and fragmentation in the AC power line waveforms delivered to the load in the "on" state. Coveley's control circuit, in particular, also provides asymmetrical waveforms. These characteristics disqualify the circuits disclosed by Coveley and Evans from being considered as electrical switches, because an electrical switch's function is to connect and to disconnect. An electrical switch is thus not permitted to draw a significant leakage current through the load during the "off" state, and is not permitted to degrade significant the amplitude and the quality of waveform of the AC power line to the load during the "on" state. In stark contrast, Applicant's claimed solid state electrical switch operates in complete current cut-off mode in the "off" state and, in the "on" state, minimizes a low voltage drop across the solid state switch (e.g., to the specification limits of a triac or an SCR)

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and operates fully dynamically with substantially no distortion of the AC power line waveform across the load, thereby maintaining high signal quality and efficiency. Thus, Applicant's design approach is thus diametrically opposite Coveley's and Evans's approaches.

Turning therefore specifically to the Office Action of July 18, 2001, the Examiner rejected Claims 1-8, 19, 27-30, 33-34 and 67 under 35 U.S.C. § 102(b) as being anticipated by Coveley. Applicant respectfully traverses the Examiner's rejection. As amended, Claim 1 recites:

> 1. A <u>solid state electrical switch</u> for controlling a electrical load, comprising:
>
> * * *
>
> a control circuit providing said control signal, said control circuit being coupled to said first and second terminals in a parallel configuration with said semiconductor switch, <u>wherein current in said control circuit is substantially cut-off in said "off" state</u>.
>
> (emphasis added)

As explained at Application Specification at page 24, line 24 to page 25, line 8 and recited in Claim 1, Applicant's control circuit operates in current cut-off mode in the "off" state, so that no current passes through the load. Since a non-conducting mechanical-contact switch on a power line typically draws almost no current in the "off" state (e.g., usually no more than few microamps of leakage current under certain environmental and relative humidity conditions), one skilled in the art would expect a solid state electrical switch to perform comparably under similar operating conditions.

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As mentioned above, the circuit Coveley discloses and relied upon by the Examiner cannot be considered as a solid state electrical switch. In fact, as explained in Coveley's col. 1, lines 15-19, Coveley discloses:

> This invention relates in general to power supplies for providing controlled power to loads such as electric lights, heaters and motors, and more particularly to a power supply capable of collecting charge during portions of an AC power supply signal during which power is not applied to the load.
>
> (emphasis added)

As shown in Coveley's Figure 1, Coveley discloses a control circuit 4 and zero detector circuit 7. Consistent with conventional thinking, Coveley provides a low voltage DC power supply circuit 5 (e.g., 5 volts) connected in parallel with switch 1 to power control circuit 4 and zero detector circuit 7. However, as explained above, due to the behaviors of Coveley's disclosed circuit in both the "on" and "off" states of the load, Coveley's circuit does not function as a solid state electrical switch.

Specifically, in Coveley's disclosed circuit, a large leakage current passes through the load. For example, during the "off" state in Coveley power supply circuit 5 (i.e., solid state switch 1 in a non-conducting state), which is described at col. 4, lines 31-51, and shown in Figure 5, the line voltage appears across the circuit of capacitor C1, resistor R8 and zener diode D4. Since Coveley teaches that capacitor C1 is 1.5 uF, for a typical AC source of 120 volts at 60 Hz, an active current having an approximate amplitude 0.1 A would be drawn through the power supply circuit and the load shown at the negative half-wave. Similarly, Coveley teaches that the power supply circuit shown in Figure 6 which draws an active current through the load. Thus, Coveley's disclosed circuit does not behave as a solid state electrical switch with current cut-off in the "off" state.

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Further, Coveley discloses that switch 1 can be implemented as a triac (Coveley's col. 2, lines 44-45). Thus during the "on" state, without more, the voltage across Coveley's control circuit 4, power supply circuit 5, and zero crossing circuit 7 equals the saturation voltage of the triac (i.e., approximately 1.5 volts), which is insufficient to provide the necessary power to operate control circuit 4 and zero crossing circuit 7. To boost the voltage across control circuit 4 and zero crossing circuit 7, so as to deliver sufficient power for these circuits to operate, Coveley adjusts a "delay angle" (see Coveley's Fig. 2 and at col. 3, line 55 to col. 4, line 12). However, such an arrangement results in the following "on" state effects unacceptable in a solid state electrical switch: (1) serious waveform distortion and fragmentation of the AC power line signal across the load; (2) the resulting asymmetrical waveforms for the positive and negative half-cycles lead to a net DC component in the voltage across the load; (3) large power loss from the solid state switch; and (4) under voltage delivered to the load. The fragmentation of the AC power line signal across the load is easily seen in Fig. 2 – only the portion of the AC power line signal indicated in Fig. 2 by "conduction angle" appears across the load. None of the deleterious "on" state effects of Coveley's circuit is present in Applicant's Claim 4, for example, which recites:

> ...said control circuit includes a dynamic feedback circuit, said dynamic feedback circuit through said control signal <u>triggering said semiconductor switch during said "on" state into conducting at the beginning of each half-cycle of an AC signal</u> of said AC power source.
>
> (emphasis added)

Note also that, during the "on" state, for a typical 10A current, for example, at a voltage drop of at least 0.7 volts across resistor R (i.e., the voltage drop across the base-emitter junction of conducting transistor Q), resistor R generates at least 0.7v * 10A = 7 watts of power loss and heat and, during the positive half-wave, the supply voltage reverse biases the base-emitter junction of transistor Q such that a large transient current surge would almost

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certainly damage transistor Q or lead to serious malfunction (see, Coveley's Fig. 1). Significantly, Coveley is concerned about the voltage drop across resistor R and the associated power dissipation that he suggested that transistor Q be fabricated from germanium (Coveley, at col. 4, lines 23-27). Coveley's disclosed circuit is thus an impractical circuit.

These effects further demonstrate that Coveley does not disclose or suggest a solid state electrical switch.

In conclusion, because the "on" and "off" state behaviors of Coveley's disclosed circuit is inconsistent with a solid state electrical circuit, Applicant respectfully submits that Claim 1 and dependent Claims 2-8, 19, 27-30, 33-34 and 67 are each allowable over Coveley. Reconsideration and allowance of Claims 1-8, 19, 27-30, 33-34 and 67 are thus requested.

Claims 1-6, 19, 27-30, 32-34 and 67 are rejected under 35 U.S.C. § 102(b) as being anticipated by Evans. Applicant respectfully traverses the Examiner's rejection. As explained above with respect to Coveley, amended Claim 1 recites:

> a control circuit providing said control signal, said control circuit being coupled to said first and second terminals in a parallel configuration with said semiconductor switch, <u>wherein current in said control circuit is substantially cut-off in said "off" state</u>.
>
> (emphasis added)

Such a control circuit that operates under current cut-off is also neither disclosed nor suggested by Evans. In fact, Evans teaches the conventional wisdom of providing a low voltage DC power supply circuit to support power control circuit 38:

> C. There must always be enough power (Voltage X Current) available across the dc branch 28 to power the control logic 38, whether the triac 19 is off or on, but should not overload the logic circuitry.

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* * *

> ... However, it is understood, that whatever the voltage and power requirements of the control logic 38 they must be met by the dc power supply. The control logic 38 of the preferred embodiment operates on approximately 3 to 18 volts and approximately 200 microamps of current. ... Once the control logic 38 has the first time been activated, the control system 10 will continuously provide power through the parallel circuit 24 in sufficient values to operate the control logic 38 in both the conducting and non-conducting modes (triac-on and triac-off modes) of the triac 19 as explained below.
>
> (col. 6, lines 30-33; col. 9, lines 32-56)

As a result, Evans's circuit is designed to have an active current in the "off" state at col. 11, lines 48-62:

> Now, as the alternating current passing through the main terminals 20, 21 of the triac 19 drops below the holding current and the triac is turned off in its normal cyclical pattern, there is insufficient gate signal to turn the triac back on. Thus, the triac 19 remains in its non-conducting (triac-off) mode. In this state, substantially all of the voltage is again across the parallel circuit 24 thus providing sufficient power to the dc power supply and control logic 38. Although <u>current continues to flow through the parallel circuit 24 along lead wires 11 and 12 to the load 15</u>, the impedance across the parallel circuit 24 is so high, due to the presence in the circuit of resistor 32, that the resulting current flowing to the load is insignificant as comapred to the current required to operate the load.
>
> (emphasis added)

Although the total current in parallel circuit 24 is not known, the active current in parallel circuit 24 is at least 8-20 milliamps for 120-220 volt operations, estimating from the 15 K-ohm value of resistor 32, as disclosed in Evans's col. 8, line 5.

In addition, to sustain the low voltage DC power supply, Evans teaches a manipulating the turn-on timing of triac 19 during "on" state:

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> Each time the traic 19 turns off (at each half cycle), an off-state voltage is developed across the main terminals 20, 21

> of the triac before the triac 19 tuns back on. The elements within the parallel circuit 24 function to predetermine a minimum threshold off-state voltage drop across points A and B (main terminals 20, 21) which must be developed each time the gate trigger voltage across points B and C is developed. … Therefore, the triac 19 will not turn on until this predetermined, minimum threshold off-state voltage across A and B is developed. <u>In accordance with the present invention, the predetermined threshold voltage drop 47 must be sufficient to satisfy the requirements of all of the elements in the parallel circuit 24 including the bridge rectifier diodes 27a, 27b, 27c, 27d, the LED 34, and the zener 35 as well as the gate trigger voltage before the triac will turn on.</u> <u>In the example of the preferred embodiment this minimum threshold voltage 47 is approximately 15 volts (resistor 32 is shorted from the circuit).</u>
>
> (emphasis added, Evan's col. 10, lines 25-46).

The distortion and fragmentation of the power waveforms at the load are clearly shown at Evan's Fig. 3E. Thus, in the "on" state, Evans' disclosed circuit suffers similar disadvantages as those suffered by Coveley, as discussed above. Further, with a 15 volts minimum threshold drop across the semiconductor switch, Evan's circuit simply does not perform as an electrical switch. As explained above, no such disadvantages are found in Applicant's solid state electrical switch. Consequently, Applicant submits that Claim 1 and its dependent Claims 2-6, 19, 27-30, 32-34 and 67 are each allowable over Evans. Reconsideration and allowance of Claims 1-6, 19, 27-30, 32-34 and 67 are requested.

Claims 9-18, 20-26, 31-32, 35-66 and 68 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Coveley. The Examiner states:

> Coveley sets forth a control circuit 4 but suggests that such provide the desired gating but not specifically a touch switch. A touch switch falls under the broad concept set forth at the bottom of col. 2 and the claimed details are well known in the art. The examiner takes official notice of the well known features of touch panels. Thus such is obvious subject matter as Coveley teaches that the control circuit provide the desired gating. As far as gain circuits are concerned, such are well known in the art adjusting signal strengths and the amount of gain is determined by the parameters at hand. Initialization is

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well known in the art so that the device always starts up in a predictable manner when initially turned on or after a power failure. The amount and type of rectification is determined by power requirements. Note that R is used for overcurrent protection. More elaborate protection circuits are well known and the examiner takes official notice of such. The claimed details of zero crossing circuits, audio circuits, and optocoupling are likewise well known in the art, and the examiner takes official notice as such.

Applicant respectfully traverses the Examiner's rejection. Claims 9-18, 20-26, 31-32, 35-66 and 68 each depend from Claim 1, and are thus believed to be each allowable over Coveley for substantially the same reasons set forth above with respect to Claim 1.

Further, as amended, Claim 9 recites:

> ...a touch panel electrically coupled to said control circuit, said touch panel providing said electrical signal when said touch panel is <u>electrically coupled to</u> an external agent.
>
> (emphasis added)

This electrical coupling of the external agent to the touch panel, and hence to the control circuit, can exhibit unobvious independence from various weather, location and operator conditions due to a complementary effect, as described in Applicant's specification, at pages 22 to 24. The complementary effect, which may result from the resistive, capacitive or inductive impedance of the external agent to ground, or from an antenna effect on the external agent, is not known in the art. As a result, the solid state switch can be reliably operated using such a touch panel under wide weather, location and operator conditions. This is a very unique and creative aspect of Applicant's invention. Perhaps the Examiner is confusing Claim 9's claimed touch panels with conventional touch panels that operate based on the mechanical motion or pressure. If the Examiner disagrees, the Examiner is respectfully requested to cite a reference to support his position, as required under MPEP §

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2144.03. Thus, Claim 9 and its dependent Claims 10-14 are each further distinguished over Coveley.

With respect to the Examiner's comment regarding Coveley's resistor R suggesting the overcurrent protection circuit of Claims 46-54, Applicant respectfully submits that the Examiner is in error. Coveley's resistor R and associated transistor Q do not constitute an overcurrent protection circuit. As is apparent to one of ordinary skill in the art, not only is resistor R ineffective in limiting a large surge current occurring during the 50% of the time when the base-emitter junction of transistor Q is reverse biased, the voltage developed across R would in fact cause a breakdown or malfunction in transistor Q in the face of a current surge. Such a glaring deficiency renders Coveley's claim of overcurrent protection absurd. In addition, the resistor R also generates power loss and heat. Claims 46-54 thus further distinguish over Coveley.

In addition, while some gain, initialization, rectification, overcurrent protection, zero-crossing, audio and opto-coupling circuits are known in the prior art, Applicant respectfully submits that the combination of any such circuits in conjunction with the recited solid state electrical semiconductor switch, or their respective benefits, are neither disclosed nor suggested by the prior art of record. Specifically, the prior art references neither disclose nor suggest incorporation of any of these circuits into the claimed control circuit, so as to operate in the "off" state with current cut-off, as recited in Applicant's claims, and without a low voltage DC power supply in the "on" state. Thus, Applicant respectfully challenges the Examiner's official notices of these circuits in the context of a solid state electrical switch under MPEP § 2144.03.

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For the above reasons, Applicant submits that Claims 9-18, 20-26, 31-32, 35-66 and 68 each further distinguish over Coveley. Accordingly, Applicant respectfully requests

withdrawal of the Examiner's rejection, reconsideration and allowance of Claims 9-18, 20-26, 31-32, 35-66 and 68.

The Examiner rejected Claims 7-18, 20-26, 31, 35-66 and 68 under 35 U.S.C. § 103(a) as being unpatentable over Evans. The Examiner states:

> Evans sets forth initialization circuitry so as to ensure proper operations under various initialization circumstances. Protection is provided at 17 and thus to use different protection schemes that are well known in the art is obvious subject matter. The details of control logic 38 are not set forth. Thus any suitable control logic will suffice to provide the desired signals. As far as gain circuits are concerned, such are well known in the art for adjusting signal strengths and the amount of gain is determined by the parameters at hand. The claimed details of zero crossing circuits, audio circuits and optocoupling are likewise well known in the art, and the examiner takes official notice as such.

Applicant respectfully traverses the Examiner's rejection. Claims 9-18, 20-26, 31-32, 35-66 and 68 each depend from Claim 1, and are thus believed to be each allowable over Evans for at least substantially the same reasons set forth above with respect to Claim 1. Furthermore, as discussed above, while some gain, initialization, over-current protection, zero-crossing, audio and opto-coupling circuits are known in the prior art, Applicant respectfully submits that the combination of any such circuits in conjunction with the recited solid state electrical semiconductor switch, or their respective benefits, are neither disclosed nor suggested by the prior art of record. Specifically, the prior art neither disclose nor suggest incorporation of any of these circuits into the claimed control circuit to operates in the "off" state with current cut-off, as recited in Applicant's claims, and without requiring in the "on" state, a significant voltage drop, distortion or fragmentation of the AC power line waveform at the load to support a low voltage DC power supply for the control circuit. For example, Applicant provides in the Specification, at pages 38-41 and at Figs. 9a-9d, examples of overcurrent protection circuits that do not have a leakage current during the "off" state, and

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are inductively coupled to the current of the load, so that the goals of minimal power loss and substantially no distortion or fragmentation of the AC power line waveforms are achieved. Thus, Applicant respectfully challenges the Examiner's official notices of these circuits in the context of a solid state electrical switch under MPEP § 2144.03. Absent prior art references showing each such combination, Applicant submits that Claims 7-18, 20-26, 31, 35-66 and 68 each further distinguish over Evans.

Further, Applicant disagrees with the Examiner's conclusion that, because Evans did not set forth the details of control logic 38, Evans suggests all suitable control logic. Applicant respectfully submits that Evan's failure to set forth the details of control logic 38 limits its relevance as prior art. Likewise, the Examiner's reasoning with respect to transient suppression circuit (TVS) 17 is equally flawed. Accordingly, Applicant respectfully request reconsideration, and allowance of Claims 7-18, 20-26, 31, 35-66 and 68.

Finally, Applicant respectfully submits to the Examiner that, unlike the Examiner's prior art references, Applicant's claimed invention as embodied in the pending claims provides a solid state electrical switch with current cut-off and waveform integrity performances at least equal to conventional mechanical-contact switches. To illustrate the substantially identical "on" and "off" state operational characteristics of a switch according to Applicant's Claim 1 and a conventional mechanical-contact power switch, and to contrast such these operational characteristics with operational characteristics in Coveley's and Evan's circuits, Applicant submits the attached Declaration of Lloyd Ebisu under 37 C.F.R. § 1.132, and Exhibit A. Exhibit A is Mr. Ebisu's waveform test report comparing the "on" and "off" state operating characteristics of a solid state electrical switch according to Applicant's Claim 1 and a conventional mechanical-contact power switch.

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In addition, the unique multi-function features of Claims 2-68, such as full static operations, overcurrent protection, high sensitive touch panels, persistent memory after power failure, automatic turned off, etc., provide new applications, unrivalled convenience and safety not seen in the prior art. Thus, Applicant's invention that provides a fully solid state two-terminal AC power switch is a significant scientific and engineering breakthrough. Prototypes of switches under Applicant's invention suitable for many applications are now available. For example, Exhibit A shows a prototype switch having substantially identical operational characteristics of a conventional mechanical-contact electrical switch (pages 7-8), and another prototype switch including, in addition, an overcurrent protection circuit (page 9) suitable for use as a circuit breaker. Because of the prevalence of power switches in modern life, so much so that the number of power switches in existence is estimated to exceed human population, Applicant's invention is a fundamental advance in the development of solid state and intelligent power switches. If the Examiner believes that an inspection or demonstration of Applicant's claimed invention in these prototypes would facilitate allowance of Applicant's claims, the Examiner is respectfully requested to grant Applicant an interview in person.

For the above reasons, Applicant believes that all pending claims (i.e., Claims 1-68) are allowable over all prior art of record, and thus respectfully requests their allowance. If the Examiner has any questions regarding the above, the Examiner is respectfully requested to telephone the undersigned Attorney for Applicants at 408-453-9200.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, Washington, D.C. 20231, on October 18, 2001.

Attorney for Applicant(s) 10/18/2001
Date of Signature

Respectfully submitted,

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<u>Version with markings to show changes made</u>

1. (Amended) A solid state electrical switch for controlling a electrical load, comprising:

a first terminal;

a second terminal;

a semiconductor switch coupled by said first terminal and said second terminal to form with said electrical load a series circuit across said AC power source, said semiconductor switch becoming conducting in response to receiving a control signal at a control terminal, said solid state electrical switch being in an "on" state when said semiconductor switch is conducting and in an "off" state when said semiconductor switch is not conducting; and

a control circuit providing said control signal, said control circuit being coupled to said first and second terminals in a parallel configuration with said semiconductor switch<u>, wherein current in said control circuit is substantially cut-off in said "off" state</u>.

9. (Amended) A solid state electrical switch as in Claim 1, further comprising a touch panel electrically coupled to said control circuit, said touch panel providing said electrical signal when said touch panel is [contacted by] <u>electrically coupled to</u> an external agent.

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11. (Amended) A solid state electrical switch as in Claim <u>9</u> [10], wherein said electrical signal [is synthesized by complementary effects resulting from the interaction of environmental electric fields and said impedance] <u>includes a component provided by electromagnetic radiation collected by said external agent</u>.

12. (Amended) A solid state electrical switch as in Claim 10, wherein said impedance [is primarily] includes a resistive component.

13. (Amended) A solid state electrical switch as in Claim 10, wherein said impedance [is primarily] includes a capacitive component.

14. (Amended) A solid state electrical switch as in Claim [10, such that electromagnetic radiation collected by said external agent contributes to said electrical signal] 9, wherein said electrical signal is provided by a complementary effect resulting from two or more of: a component provided by electromagnetic radiation collected by said external agent, a resistive component in an impedance of said agent to ground, a capacitive component of said impedance, and an inductive component of said impedance.

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